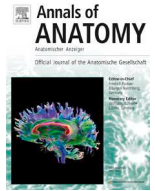




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## Research article

# Evaluation of the effectiveness of online education in anatomy for medical students during the COVID-19 pandemic



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## ARTICLE INFO

## Article history:

Received 26 January 2022

Received in revised form 21 May 2022

Accepted 8 June 2022

Available online 20 June 2022

## Keywords:

COVID-19

Teaching anatomy

Cadaveric specimens

Virtual teaching

Satisfaction index

## ABSTRACT

**Background:** In the field of medicine, anatomy is considered one of the most important subjects to be studied in college, even for clinicians. Learning from cadaveric specimens is considered an important part of the medical experience. The current study consisted of a questionnaire given to Year 1 and Year 2 medical students. This study was performed to assess using a questionnaire whether students were capable of continuing studying Anatomy during the COVID-19 period.

**Methods:** The study consisted of 102 students in Years 1 and 2 of the Faculty of Medicine of Alexandria University in Egypt. It included Year 1 Students (mean age  $18.6 \pm 1.1$  years old; 21 males and 36 females), and Year 2 Students (mean age  $20.4 \pm 1.0$  years old; 22 males and 23 females).

The survey consisted of three sections. The first section consisted of four questions on the demographic data of the participating students. The second section consisted of 10 questions concerning their satisfaction with the tutorials and presented by the Department of Anatomy. Answers to the questionnaire were in the form of a Likert scale (with 1 = strongly disagree to 5 = strongly agree).

**Results:** The students disagreed with the fact that they found difficulty in time management, represented by a mean score of  $2.23 \pm 1.14$ . That is to say, the students were capable of managing their time well. Here also, the difference between Year 1 and Year 2 students was significant ( $p = 0.028$ ), which is an indicator that Year 2 students found more difficulty in time management. Most students agreed (mean score of  $3.48 \pm 1.07$ ) that they were able to handle online learning and the transition between the systems was acceptable. Students were also convinced and agreed that the methods used by the college limited the spread of COVID-19 (mean score of  $3.81 \pm 1.04$ ). Allowing assignments and projects increased the interaction between the students and the staff members.

**Conclusions:** Education must continue during the COVID-19 period, based on their responses and opinions in the questionnaire. Online learning proved to be effective in teaching medical students during the COVID-19 pandemic.

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## 1. Background

The spread of the COVID-19 pandemic has affected many parts of the world and has impacted the educational systems and the social environment (Bozkurt, 2020; Sadeesh et al., 2021). Face-to-face education, which is considered by many researchers as the main method of teaching, has become an important target in most countries, where all are trying different methods to attain and maintain it (Daniel, 2020). The suspension of education in many

countries and the activation of distance learning is considered the mainstay alternative to avoid the spread of the current pandemic. The present COVID-19 situation does not have a clear ending date and is considered by this generation as the first encounter with such a problem (Babacan and Dogru Yuvarlakbas, 2022).

In the field of medicine, anatomy is considered as one of the most important subjects to be studied in college, even for the clinicians. Learning from cadaveric specimens is considered an important part of the medical experience (Pather et al., 2020). Cadaver-based learning has a negative impact, both physically and emotionally. It leads to nausea, dizziness, anxiety, and a sense of fear of death, usually following the first time a student dissects or visualises a cadaver (Wu et al., 2021).

As a result of the COVID-19 pandemic and the present changes that occurred, lots of the practical sessions have been influenced and

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cancelled in many parts of the globe. Online education has been the most accepted option to continue the teaching of students and to prevent the abrupt stoppage of the medical curricula (Srinivasan, 2020).

The COVID-19 period has also affected body donations. There is fear of getting infected by the cadavers, so there is more thought about protection and using well ventilated rooms during the embalming process (Lemos et al., 2021). New laws in Italy have limited the use of body donations (De Caro et al., 2021), and some universities, like the University of Bologna, asked for some changes in this law, as they feared their successful body donation programme might have a reduction in donors as a result of the new laws in Italy and the COVID-19 pandemic (Orsini et al., 2021).

Moreover, healthcare providers need to have a thorough understanding of anatomy as it is considered the cornerstone of basic medical education (Saverino, 2021). Anatomy teaching has been affected by the COVID-19 pandemic. There has been a significant fall in the amount and the level of education in anatomy as a result of COVID-19 (Franchi, 2020).

Teaching by the use of virtual means is not considered a novel method of teaching students (Kentnor, 2015; Pant, 2014). In previous years, it was considered an adjuvant to education and not an essential method, but now the dependence on these new technological methods is turning out to be more and more necessary (Alkhowailed et al., 2020; Tabatabai, 2020; Walker and Fraser, 2005). The advantages of the online methods are considered by many studies to be endless and include being available at any needed time, being easier to attend, and saving time in reaching the destination. But this is not without some defects, such as being isolated from the community and losing motivation to study and learn (Panchabakesan, 2011).

By using this online method as a transient solution to continue education, it seems to be acceptable to many people (Chiu et al., 2005; Geis et al., 1986; Guy and Lownes-Jackson, 2015; Roach and Lemasters, 2006; Strong, 2012; Sweet, 1986). Opinions about virtual teaching have been and still are controversial (Chiu et al., 2005; Sweet, 1986). The defects of virtual techniques are on the rise as complaints about students not being capable of completing courses and thus leaving them are occurring (Geis et al., 1986; Panchabakesan, 2011; Sweet, 1986).

During this time, education should be flexible, and we should try to move along and enhance its level. Finding solutions along the way is the best way to continue (Ari et al., 2003). Video-based learning, team-based learning, and peer teaching are some of the methods used now to continue the anatomy educational system. By using all these teaching techniques, the aim is to keep the students engaged in studying and not to lose their attention and interest (Saverino, 2021). Feedback from the students also helps us to know that we are moving in the correct direction and that the level of education is maintained as much as possible during these times (Kulik, 2001).

In Egypt, the beginning of online teaching and the replacement of lectures with online videos was considered a new encounter. This presented many challenges for the students, as they struggled to continue studying the medical material. So we designed this questionnaire to be able to analyze the current situation of the teaching method in the Faculty of Medicine of Alexandria University for both Year 1 and Year 2 medical college students.

This study was performed to evaluate the effectiveness of online methods and whether or not students benefited from them.

## 2. Material and methods

### 2.1. Study design and population

Our medical school runs a 5-year programme where Years 1 and 2 mainly address the basic sciences integrated with clinical sciences,

while in Years 3, 4 and 5, the students rotate in clinical clerkships at the hospitals.

The current study took place during the second term of the academic year 2020–2021. The participants were first-year (second semester) and second-year (fourth semester) medical students attending the courses on musculoskeletal and nervous systems, respectively, at the Faculty of Medicine, University of Alexandria.

The pre-COVID-19 era weekly schedule of the musculoskeletal system anatomy course for the first-year students consisted of two-hour practical laboratory sessions given twice weekly, for fifteen weeks (an average total of sixty hours). The sessions included anatomical structures' demonstration on dried cadaveric bones and a wet lab using prosected specimens. The theoretical lectures included thirty-five face-to-face lectures given to the students.

As for the second-year students, the nervous system course in the pre-COVID-19 era included a two-hour practical laboratory session given once per week for fifteen weeks (an average total of thirty hours). The two-hour laboratory education consisted of demonstration of anatomical structures on plastic anatomical models of the brain and a wet lab using prosected specimens. The theoretical lectures included twenty-three lectures given face-to-face to the students.

After the enforcement of emergency measures and the transition of the Faculty of Medicine to remote work, the musculoskeletal anatomy and nervous system courses had to change.

The musculoskeletal system anatomy course became weekly and consisted of two, 'one hour and twenty minutes,' of laboratory practical sessions. Tutorials were used in the form of PowerPoint pictures of the system and were presented to small groups of students within large halls. At the end of the practical tutorials, demonstrations of dried cadaveric bones and wet specimens were shown. To avoid overcrowding on the specimens, five students at a time came to observe the specimens. The attendance was taken when the students attended the practical sessions in college. The theoretical lectures were prerecorded at one hour each, for a total of thirty-five lectures. The online lectures were presented on the Moodle platform.

As for the nervous system module, it consisted of one hour and twenty minutes of laboratory practical sessions once per week. In the tutorial practical sessions, PowerPoint presentations with anatomical diagrams and pictures of the specimens were used in the tutorial. Also, anatomical structure demonstrations on plastic models and specimens were done in the same way as the musculoskeletal system. The attendance was taken when the students attended the practical sessions in college. The theoretical lectures were prerecorded at one hour each, for a total of twenty-three lectures. The online lectures were also presented on the Moodle platform.

In both Years 1 and 2, theoretical exams were taken online and consisted of multiple choice questions and short essay questions. As for the practical exams, they were taken in college inside the computer labs, where identification questions were asked on the anatomical diagrams.

### 2.2. Participants

A questionnaire was used in the study. The participation of the students took place after informed consent was obtained from them.

The questionnaire was sent to 105 medical students selected at random (population) in both Years 1 and 2 of the Faculty of Medicine of Alexandria University in Egypt. There were 102 students (sample) who completed the questionnaire.

There was a comparison between Years 1 and 2. This was because Year 2 had experienced both types of education in the Anatomy Department, using both the traditional modular face-to-face

teaching and the online methods. On the other hand, Year 1 had just tried the distance methods of teaching anatomy.

### 2.3. Evaluation

A questionnaire was designed and sent to the students, including Likert questions, having a scale of 1 with strongly disagreed to 5 with strongly agreed via a Google Form.

The questionnaire was used to convey the online teaching and its application and the addition of assignments to the education. This was to allow more student-doctor interaction, so as not to lose contact with the students.

The assignments were done by sending out topics to the students in groups of ten. The topics were selected according to the module being studied by the students. In Year 1, topics were selected from the musculoskeletal module, while in Year 2, topics were selected from the nervous system module. The group would divide the topic into subtopics, where each student would do their part. At the end, one student was to collect all the subtopics into a single word document. They would then summarise the main points into a PowerPoint presentation. This was under the supervision and guidance of the staff members in the Anatomy Department. Finally, a presentation would be done over Zoom, which was assessed by a staff member, and grades were given according to the parameters set by the college.

### 2.4. Sections of the survey

The survey consisted of three sections. The first section consisted of demographic data. The second section consisted of questions concerning their satisfaction with the tutorials. The third section consisted of a comparison of Year 2 students' results (class of 2019).

Their results in the musculoskeletal module, which they took using traditional methods before the COVID-19 pandemic, were compared with their results in the nervous module, which they completed using distant digital methods during the COVID-19 pandemic. This was done so that we could compare the same students using different methods of teaching so that there is no difference in the student capabilities. There is a difference in the module itself, but this could not be avoided.

In the first section, demographic data included their gender, their academic year, and their age group.

In the second section, answers to the questionnaire were in the form of a Likert scale (with 1 = strongly disagree to 5 = strongly agree). There were two questions (questions 1 and 2) that were negative. Thus, these were scored in the opposite manner (with 1 = strongly agree and 5 = strongly disagree). The Cronbach's alpha was 0.645 for the second section.

The satisfaction rate was used for Section 2. It was determined by:

-Total satisfied: [(total number of participants with positive responses (strongly agree and agree)) divided over the total number of responses] multiplied by 100.

-Total dissatisfied: [(total number of participants with negative responses (strongly disagree and disagree)) divided over the total number of responses] multiplied by 100.

The satisfaction index of the questions in Section 2 was calculated using the following formula (Guilbert, 1998):

-Satisfaction index:

$$\frac{[(n1 \times 1) + (n2 \times 2) + (n4 \times 4) + (n5 \times 5)]}{n1 + n2 + n4 + n5} \times 100$$

$$(n1 + n2 + n4 + n5) \times 5$$

Where:

n1 = Number of participants who opted for 'strongly disagree.'

n2 = Number of participants who opted for 'disagree.'

n4 = Number of participants who opted for 'agree.'

n5 = Number of participants who opted for 'strongly agree.'

### 2.5. Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Qualitative data was described using number and percent. Quantitative data was described using range (minimum and maximum), mean and standard deviation. Student t-test was used to compare two groups for normally distributed quantitative variables. Reliability statistics were assessed using Cronbach's Alpha test. Kendall's Tau-b was used to correlate between quantitative variables. Kendall's Tau-b was used as a test of viability. Cohen's d is defined as the difference between two means divided by a standard deviation for the data. Cohen's d was used to determine effect size. Significance of the obtained results was judged at the 5% level.

## 3. Results

### 3.1. Demographic data

Most of the students were females (59 students). Moreover, most students were Year 1 medical students (57 students). Most students were 19–20 years old (54 students). The method of attendance was least by desktop (1 student) and most by phone (58 students) (Table 1).

### 3.2. Questionnaire answers of medical students

Whether or not students were distracted by home comforts was asked, and it was found that most students agreed (31 students) that they did. We also asked if the students had difficulty with time management, and there was also a large number of students who both agreed (31 students) and strongly agreed (33 students) with this statement.

Many students agreed that they could handle online learning (38 students). The students were convinced and agreed (42 students) that this method protected them from the spread of COVID-19. Most students had neutral feelings towards the ease of online lectures (44 students) and the effectiveness of this method for teaching them (34 students).

The majority of students (54 students) strongly agreed that they missed face-to-face interaction. The students agreed that the assignments were easy to complete (44 students) and beneficial (50 students). The assignment as a method of assessment was considered by many students as strongly agreeing (46 students) (Table 2) (Fig. 1).

**Table 1**

The distribution of Year 1 and Year 2 medical students according to their demographic data and Year 2 students' results (Section 1) (n = 102).

	Demographic data	No. (%)
1	<b>Gender</b>	
	Male	43 (42.2%)
2	Female	59 (57.8%)
	<b>Age group</b>	
	17–18 years old	27 (26.5%)
3	19–20 years old	54 (52.9%)
	21–22 years old	21 (20.6%)
4	<b>Year in medical college</b>	
	Year 1	57 (55.9%)
5	Year 2	45 (44.1%)
	<b>Method of attendance of online classes</b>	
	Phone	58 (56.9%)
6	Laptop	43 (42.2%)
	Desktop	1 (1.0%)

**Table 2**

Distribution of the answers of the medical students to the questionnaire given to them (Section 2) (n = 102).

Q	Strongly disagree		Disagree		Neutral		Agree		Strongly agree		Mean ± SD.
	No.	%	No.	%	No.	%	No.	%	No.	%	
1 Do you feel distracted by home comforts?	9	8.8	23	22.5	15	14.7	31	30.4	24	23.5	2.63 ± 1.30
2 Do you find difficulty in time management?	6	5.9	6	5.9	26	25.5	31	30.4	33	32.4	2.23 ± 1.14
3 Can you handle online learning?	5	4.9	13	12.7	29	28.4	38	37.3	17	16.7	3.48 ± 1.07
4 Using these methods limited the spread of COVID-19?	1	1.0	15	14.7	15	14.7	42	41.2	29	28.4	3.81 ± 1.04
5 Where online lectures easy to follow?	3	2.9	13	12.7	44	43.1	33	32.4	9	8.8	3.31 ± 0.91
6 Online teaching of lectures is effective in teaching students.	13	12.7	25	24.5	34	33.3	20	19.6	10	9.8	2.89 ± 1.16
7 Do you miss face-to-face lectures?	3	2.9	3	2.9	14	13.7	28	27.5	54	52.9	4.25 ± 1.00
8 The assignment in anatomy was easy to complete.	3	2.9	1	1.0	15	14.7	44	43.1	39	38.2	4.13 ± 0.91
9 The assignment was beneficial.	0	0.0	2	2.0	12	11.8	50	49.0	38	37.3	4.22 ± 0.73
10 The assignment is a good method for assessment.	0	0.0	7	6.9	12	11.8	37	36.3	46	45.1	4.20 ± 0.90
<b>Average score</b>											
Min. - Max.	2.6 - 4.6										
Mean ± SD.	3.74 ± 0.39										

Data was expressed by Mean ± SD.

### 3.3. Comparison between the questionnaire answers of Year 1 and Year 2 medical students

As for the difference in responses between Year 1 and Year 2 medical students, there was no significant difference except in 4 questions where Year 2 students found it more difficult in time management and were more distracted by their home comforts as compared with Year 1. On the other hand, Year 2 students found the assignment easy and more beneficial as compared with the students of Year 1 (Table 3).

### 3.4. Correlation between the average score and the different questions of the questionnaire

To assess validity, a correlation was conducted between the average score and the questions within Section 2 using Kendall's Tau-b (Table 4). There was a strong positive significant correlation in all questions except question 8.

### 3.5. Cohen's d between Years 1 and 2 according to the different questions of the questionnaire

The effect size was measured using Cohen's d (Table 5). In questions 2 and 3, the effect size was 0.4, which is considered a small effect. It was within the zone of desired effects according to Hattie's

effect size. In questions 9 and 10, the Cohen's d value was 0.6 and 0.5, respectively, which indicates an intermediate effect. It was also within the zone of desired effects, according to Hattie's effect size.

### 3.6. The satisfaction rate of the answers of the medical students

The satisfaction rate shows that the total satisfied percentage was generally more than the total dissatisfied percentage. The maximum total satisfaction was 86 % in question 10. This is a strong indicator that students liked assignments as a method of their assessment in university education during the COVID-19 period. Maximum total dissatisfaction was 37 % in question 7. According to the students' point of view, online lectures were considered less effective in teaching them (Fig. 2).

### 3.7. The satisfaction index of the answers of the medical students

The satisfaction index was highest in question 8, at 89 %. The least percentage was 57 %, and this was noted in question 7. Thus, online systems can only be considered as a bridge to continue education during the time of COVID-19 but cannot be continued endlessly (Fig. 3).

## Results of the questionnaire of the students according to the Likert scale score in Section 2 (mean ± standard deviation)

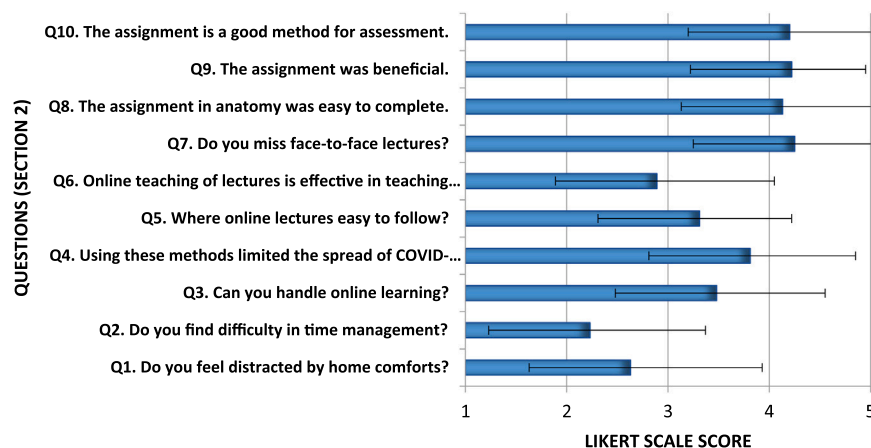


Fig. 1. The distribution of the results of the questionnaire of the students according to the Likert scale score (Section 2).

**Table 3**

Comparison between the answers of Year 1 and Year 2 medical students according to the questionnaire given to them (Section 2) (n = 102).

Q	Year 1 (n = 57)	Year 2 (n = 45)	t	p
1	2.39 ± 1.25	2.93 ± 1.32	2.141*	0.035*
2	2.00 ± 1.00	2.51 ± 1.25	2.230*	0.028*
3	3.33 ± 1.09	3.67 ± 1.02	1.575	0.118
4	3.74 ± 1.08	3.91 ± 1.00	0.838	0.404
5	3.19 ± 0.93	3.47 ± 0.87	1.515	0.133
6	2.88 ± 1.21	2.91 ± 1.10	0.146	0.884
7	4.32 ± 1.02	4.16 ± 0.98	0.803	0.424
8	3.91 ± 0.91	4.40 ± 0.84	2.781*	0.006*
9	4.07 ± 0.78	4.40 ± 0.62	2.327*	0.022*
10	4.09 ± 0.97	4.33 ± 0.80	1.372	0.173
	<b>Average score</b>	<b>3.39 ± 0.50</b>	<b>2.872*</b>	<b>0.005*</b>

Data was expressed by Mean ± SD.

D: Standard deviation

t: Student t-test

p: p value for comparing between Year 1 and Year 2

\*Statistically significant at p ≤ 0.05

### 3.8. Comparison of Year 2 students' results before and during the COVID-19 pandemic

Most Year 2 students got 80–89% in the musculoskeletal module (15 students), and in the nervous system module, most students got 90–100% (18 students) (Table 6).

## 4. Discussion

### 4.1. Challenges of teaching anatomy during the COVID-19 period

The need to continue teaching anatomy during the COVID-19 period is considered a challenge due to the need for practical sessions and the use of cadavers. Lots of barriers have risen during this time and have affected the way anatomy is taught. The use of digital education during this time has become essential. Although these teaching methods might not be the most favoured, they are considered the optimum choice during the COVID-19 period, as they have been able to reduce the spread of the disease. The current condition of the theoretical lectures being taught online is thought by many as a defect; but only the future will decide what the next step in the teaching of anatomy is.

Tschernig et al. (2022) also found problems where some cadaveric specimens were infected with COVID-19. In this case, the cadavers had to be cremated. Other problems were also found. The continuation of the anatomical courses was suspected to have led to the spread of the COVID-19 virus.

It is recommended that all bodies donated to the Anatomy Department throughout the world should undergo postmortem rapid antigen testing for the COVID-19 virus. This is to exclude that the donated body could be infected with the COVID-19 virus and

**Table 5**

Cohen's d between Years 1 and 2 according to the different questions of the questionnaire (Section 2) (n = 102).

Q	Cohen's d
1	0.4
2	0.4
3	0.3
4	0.2
5	0.3
6	0.0
7	0.2
8	0.6
9	0.5
10	0.3
	<b>Average score</b>
	0.6
<b>Cohen's d</b>	<b>Interpretation sensu Cohen's d</b>
0	No effect
0.1	
0.2	Small effect
0.3	
0.4	
0.5	Intermediate effect
0.6	
0.7	
0.8	Large effect
0.9	
≥ 1.0	
	<b>Interpretation sensu Hattie</b>
	Developmental effects
	Teacher effects
	Zone of desired effects

**Table 4**

Correlation between the average score and the different questions of the questionnaire (Section 2) (n = 102).

Q		Average score	
		Kendall's Tau-b	p
1	Do you feel distracted by home comforts	0.460	< 0.001*
2	Do you find difficulty in time management	0.334	< 0.001*
3	Can you handle online learning	0.639	< 0.001*
4	Using these methods limited the spread of COVID-19	0.555	< 0.001*
5	Online lectures were easy to follow?	0.570	< 0.001*
6	Online teaching of lectures is effective in teaching students	0.518	< 0.001*
7	Do you miss face-to-face lectures	-0.231	0.003*
8	The assignment in anatomy was easy to complete	0.401	< 0.001*
9	The assignment was beneficial	0.392	< 0.001*
10	The assignment is a good method for assessment	0.427	< 0.001*

\*Statistically significant at p ≤ 0.05

### Satisfaction rate of answers of medical students according to the questionnaire in Section 2

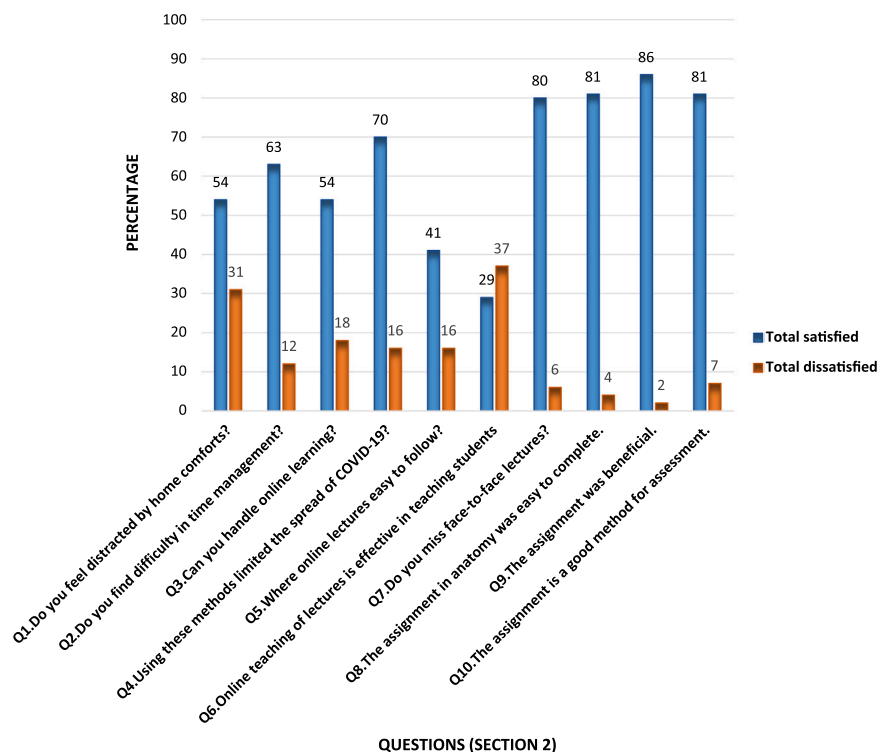


Fig. 2. The satisfaction rate of the answers of the medical students according to the questionnaire given to them (Section 2).

might lead to the spread of the virus to all those who handle the donated body. If the cause of death was mentioned as a result of the virus, the body should not be accepted from the start.

#### 4.2. Preferred method of attendance for the online anatomy course

The ratio of male to female students was 43 students to 59 students, respectively, with a higher level of female students. Year 1 students were more in number than Year 2 students, where there was a difference of 7 students between the Year 1 and Year 2 groups. Most students attended online classes using their phone (56.9%), followed by the laptop, which was used by 42.2% of the students, and only 1 student attended online classes using the desktop. This could be due to the ease of use of phones and their accessibility, making them the number one choice for their use in online learning. Also, Egypt being a developing country might mean that some students would have financial difficulty affording a laptop or a desktop. The only option then would be that the students use their phones.

Thomas et al. (2015) found in comparison to our study that most students using e-tutorials preferred the use of laptops, reaching 96.43% as compared to the use of smartphones, which was less. This could be due to the fact that laptops are more versatile in handling, allowing for more options and choices.

#### 4.3. Difficulties of online learning

Home comforts as a distracting factor to online learning seemed to be in neutrality, having a mean score of  $2.63 \pm 1.30$ . There was a statistically significant difference between Year 1 and Year 2 students, where Year 2 students were more distracted than Year 1 students ( $p=0.035$ ). This can be explained by the fact that newer generations find it easier to learn from online material as compared to older ones.

Babacan and Dogru Yuvarlakbas (2022) found that 38.4% strongly agreed that they could not focus as there was no classroom environment in remote anatomy lessons, followed by 24.7% who also agreed with the same statement. This is similar to our study where students generally found difficulty focusing.

On the other hand, the students disagreed with the fact that they found difficulty in time management, represented by a mean score of  $2.23 \pm 1.14$ . That is to say, the students were capable of managing their time well. Here also, the difference between Year 1 and Year 2 students was significant ( $p=0.028$ ), which is an indicator that Year 2 students found more difficulty in time management. This can be explained by the fact that Year 1 students did not try face-to-face lectures, so they had no comparison point.

In another study, they found similar results to ours, where they also had students who found difficulty in time management and were distracted by home comforts. The study also showed a 69% drop in motivation (Singal et al., 2021). To balance it, there was a positive aspect, as the students felt they were more at ease as to when to study (Shahrvini et al., 2021).

Students can improve time management by following the timetable which is sent to them via the Moodle portal and listening to the prerecorded lectures at the set times. Students can also limit screen time and avoid excessive social media like Facebook, Instagram, and Twitter.

#### 4.4. Positive aspects of online learning

Most students agreed (mean score of  $3.48 \pm 1.07$ ) that they were able to handle online learning and the transition between the systems was acceptable. Students were also convinced and agreed that the methods used by the college limited the spread of COVID-19 (mean score of  $3.81 \pm 1.04$ ).

### Satisfaction index of answers of medical students according to the questionnaire in Section 2

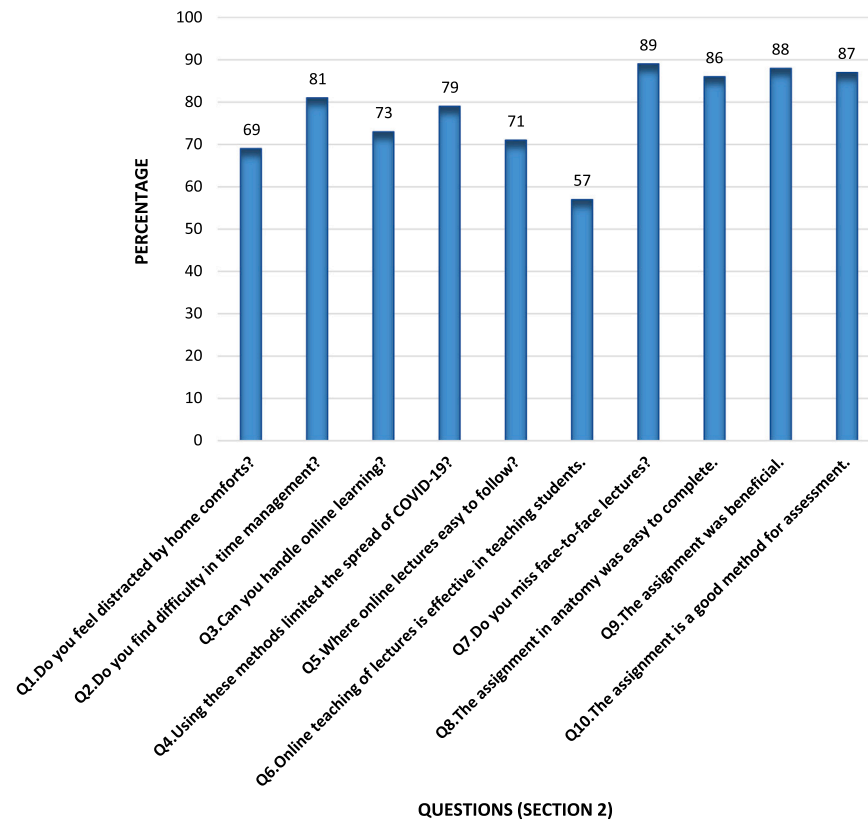


Fig. 3. The satisfaction index of the answers of the medical students according to the questionnaire given to them (Section 2).

Table 6

Distribution of comparison of Year 2 students' results before and during the COVID-19 pandemic (Section 3) (n = 45).

	Year 2 students' results	No. (%)
1	<b>Exam score in musculoskeletal module</b>	
	90–100 %	13 (29 %)
	80–89 %	15 (33.3 %)
	70–79 %	11 (24.4 %)
	Less than 70 %	6 (13.3 %)
2	<b>Exam score in nervous system module</b>	
	90–100 %	18 (40 %)
	80–89 %	13 (28.9 %)
	70–79 %	9 (20 %)
	Less than 70 %	5 (11.1 %)

Davis et al. (2014) found that in Year 1, only 37 % found that computer-aided learning was useful, as compared to Year 2 students, where 32 % found that computer-aided learning was useful. In their study, Year 1 students disagreed by 49 % that they could replace traditional methods with digital resources. Oppositely, Year 2 students responded that they could replace traditional methods with digital by 54%. The differences in opinion in Davis et al. (2014) were considered as individual preferences rather than a general trend in results, which could be affected by the material taught in Year 1 and in Year 2 in their college.

At a neutral point (mean score of  $3.31 \pm 0.91$ ), the ease of following the online lectures included that some lectures were easier to follow than others. Also, the affectivity of online learning was neutral (mean score of  $2.89 \pm 1.16$ ).

In other studies, such as Keller et al. (2020), surgery is now being shifted to be studied via software platforms rather than traditional

methods of learning. Also, there is the addition of virtual reality platforms to increase the interaction and training of the surgeons. In a similar case, anatomy is also developing, where more software is being used and anatomical dissection tables as the Anatomage Table have been added to the department and are ready to use to help in anatomy teaching.

Other studies similar to ours had recorded lectures, and the students there were happy with the outcomes (Kelsey et al., 2020). However, there was always a dark spot in other studies, where there was a lack of interest in watching the videos and thus a decrease in the views (Longhurst et al., 2020).

In the case of Böckers et al. (2021), it was mentioned that these methods should be taken in a positive attitude, as a “blueprint” to manage similar problems. In the future, it could be used as a method to overcome the spread of disease and continue the educational process.

New methods are also being added to the teaching of anatomy, such as augmented and virtual reality. Taylor et al. (2022) mention the application of such methods in anatomy and consider them a good aid in teaching. The main limitation of these new methods is their cost.

#### 4.5. The importance of face-to-face interaction

At the highest point of agreement (mean value of  $4.25 \pm 1.00$ ), the majority of students missed face-to-face learning. This is an indicator of the importance of face-to-face interaction for the teaching of students.

Stambough et al. (2020) wrote about orthopaedic teaching during the COVID-19 period, and he also found that surgeons wanted face-to-face interaction in the case of their teaching methods. They



discovered that digital methods can supplement but not replace direct human interaction in all stages of medical education. It seems that students need to meet and learn together to improve their skills and to be motivated to learn.

Also, in [Darici et al. \(2021\)](#), where a fully digital histology course was used, similar findings were found, where students had problems becoming passive learners and losing social interactions. [Darici et al. \(2021\)](#) mentioned that they were able to overcome these problems by using group work in breakout sessions and enforcing attendance using webcams.

Some studies, like [Tabatabai \(2020\)](#), found that online learning can only be accepted as a bridging solution during the COVID-19 period and cannot be accepted as a principal method of education. But this should not limit the advancement in anatomy education, and there should be more and more development in the techniques and options in the ways anatomy is taught ([Pather et al., 2020](#)).

The loss or reduction of the doctor-student interaction during lectures cannot be forgotten by most studies ([Dixon, 2010](#); [Wallace, 2003](#)). [Wallace \(2003\)](#) stated that the loss of motivation cannot be overlooked, as it is the main complaint of the students. As humans are social in nature, the loss of face-to-face interactions affects many.

#### 4.6. The assignment as a tool for medical students' evaluation and assessment

To assess the assignment, the students were asked if it was easy, and the response came with an agreement (mean score of  $4.13 \pm 0.91$ ). A significant difference ( $p = 0.006$ ) lay between Year 1 and Year 2 students, where Year 2 students strongly agreed (mean value of  $4.40 \pm 0.84$ ) that the assignment was simple. Year 2 students had experience of completing assignment work, and they felt that they were comfortable with it.

The students also found that they benefited from the assignment (mean score:  $4.22 \pm 0.73$ ). Here again, Year 2 students strongly agreed (mean value of  $4.33 \pm 0.80$ ) that they found the assignment beneficial as compared to Year 1 students ( $p = 0.022$ ).

Year 2 had experience of completing the assignment work. The students also agreed with the fact that the assignment is a good method for assessment (mean score of  $4.20 \pm 0.90$ ).

Some studies used practical exams to assess the students, as in [Maslarski et al. \(2021\)](#), who used software-based exams and images to identify structures. In their study, they found that there was a minor difference in results between the traditional methods and the digital ones, indicating that digital teaching was capable of completing its task of maintaining education during the COVID-19 period. The study does mention that there were some limitations in the data, but they were generally accepted as they compared the new years' results with the old. This means that they were not the same students, which could add doubt to the results, as there are individual variations in the ability to study and get examined.

#### 4.7. Exam scores of Year 2 students

The exam scores of Year 2 students for the musculoskeletal and nervous system modules were collected. This was done to compare the same students in different educational methods, both traditional and online.

The results showed that there was an increase in the number of students who scored between 90% and 100%, having a difference of 11 % increase using the online system. There was also a reduction in the number of students having a score of less than 70 % by 2.2 % using the online system.

These are all positive signs that indicate that the online system improved the results of the students, and more students were generally capable of getting higher scores.

The reason behind this improvement could be that students took the theoretical exams from their homes, where they were less stressed than those who went to the examinations inside the exam halls within the college. Also, it could be because they were closer to hot drinks and water at home, which could help them concentrate and stay hydrated throughout the exam.

The practical exam was also completed on a computer in college. This meant that the students did not have to identify structures on cadaveric specimens, but rather on diagrams, which is simpler. Thus, the students were able to achieve higher scores and improve their outcomes.

These findings were similar to other studies, such as [Yoo et al. \(2021\)](#), where in their study they found that the mean total score in the 2019 class was 71.33 %, and in the 2020 class the mean total score was 76.79 %, which showed an increase of 5.46 %. The 2019 class was using traditional methods and the 2020 class was using the online method of teaching.

On the other hand, studies like [Yun et al. \(2022\)](#), found there was a drop of around 5% in the exam scores between the classes of 2019 and 2020. This is an indicator that online methods weren't successful in the Seoul National University College of Medicine.

## 5. Conclusions

During the COVID-19 period, education must continue. Online learning proved to be effective according to the students' results and their opinions in the questionnaire that was sent to them. Moreover, they found that assignments were beneficial, and they were capable of completing them. Until COVID-19 hopefully comes to an end, the techniques in teaching and the use of technology will still be implemented.

It is recommended that this study be generalised over multiple medical universities in Egypt to see the different opinions of students who are taught anatomy. Also, the questionnaire can be sent to students in the Faculty of Dentistry and Faculty of Pharmacy, as they are also taught anatomy as part of their curricula.

### Limitations of the study

The study needed to include a larger portion of the student body. Also, more questions could have been added to the questionnaire.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Acknowledgments

The author would like to thank all the individuals who have completed the survey.

### Ethical approval

The current study was reviewed and approved by the Ethical Committee of the Faculty of Medicine, Alexandria University.

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